

UNITED STATES PATENT AND TRADEMARK OFFICE  
**CERTIFICATE OF CORRECTION**

PATENT NO. : 7,197,625 B1  
APPLICATION NO. : 09/662832  
DATED : March 27, 2007  
INVENTOR(S) : Van Hook et al.

Page 1 of 19

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

**Title Page**

Item [63], Related U.S. Application Data section please replace "5,266,738" with  
--5,266,758--.

Item [63], Related U.S. Application Data section please replace "5,933,630" with  
--5,933,650--.

Title page illustrating a fig. should be deleted, and replaced with new title page  
illustrating a fig. (attached).

**Drawings**

Delete Drawing Sheets 1-17, and replace with Drawing Sheets 1-17. (attached)

**Column 16**

Line 3 replace "(SIMS)" with --(SIMD)--.

Line 11 replace "data byte and" with --data bytes and--.

Line 19 replace "comprising" with --comprising: --.

Line 33 replace "avector" with --a vector--.

Line 39 replace "unit." with --unit--.

Line 44 replace "writers" with --writes--.

**Column 17**

Line 23 replace "specified specified" with --specified--.

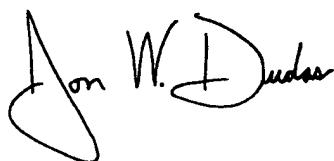
**Column 18**

Line 11 replace "data of" with --data elements of--.

Line 22 replace "ordering mod." with --ordering mode--.

Signed and Sealed this

Eleventh Day of December, 2007



JON W. DUDAS  
*Director of the United States Patent and Trademark Office*

(12) United States Patent  
van Hook et al.(10) Patent No.: US 7,197,625 B1  
(45) Date of Patent: \*Mar. 27, 2007

(54) ALIGNMENT AND ORDERING OF VECTOR ELEMENTS FOR SINGLE INSTRUCTION MULTIPLE DATA PROCESSING

3,916,388 A 10/1975 Shump et al. .... 340/172.5

(75) Inventors: Timothy J. van Hook, Atherton; Peter Hsu, Fremont; William A. Huffman, Los Gatos; Henry P. Moreton, Woodside; Earl A. Killian, Los Altos Hills, all of CA (US)

EP 0 681 236 A1 11/1995  
EP 0 681 236 B1 11/2000  
WO WO 97/07450 A1 2/1997  
WO WO 97/08608 A1 3/1997

(73) Assignee: MIPS Technologies, Inc., Mountain View, CA (US)

## FOREIGN PATENT DOCUMENTS

(\*.) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 151 days.

## OTHER PUBLICATIONS

*An Introduction to Thumb™, Version 2.0, Advanced RISC Machines, 29 pages (Mar. 1995).*

(Continued)

(21) Appl. No.: 09/662,832

Primary Examiner—Daniel H. Pan  
(74) Attorney, Agent, or Firm—Sterne Kessler Goldstein & Fox PLLC

(22) Filed: Sep. 15, 2000

## (57) ABSTRACT

## Related U.S. Application Data

The present invention provides alignment and ordering of vector elements for SIMD processing. In the alignment of vector elements for SIMD processing, one vector is loaded from a memory unit into a first register and another vector is loaded from the memory unit into a second register. The first vector contains a first byte of an aligned vector to be generated. Then, a starting byte specifying the first byte of an aligned vector is determined. Next, a vector is extracted from the first register and the second register beginning from the first bit in the first byte of the first register continuing through the bits in the second register. Finally, the extracted vector is replicated into a third register such that the third register contains a plurality of elements aligned for SIMD processing. In the ordering of vector elements for SIMD processing, a first vector is loaded from a memory unit into a first register and a second vector is loaded from the memory unit into a second register. Then, a subset of elements are selected from the first register and the second register. The elements from the subset are then replicated into the elements in the third register in a particular order suitable for subsequent SIMD vector processing.

(63) Continuation of application No. 09/263,798, filed on Mar. 5, 1999, now Pat. No. 6,266,738, which is a continuation of application No. 08/947,649, filed on Oct. 9, 1997, now Pat. No. 5,933,630.

(51) Int. Cl.  
G06F 15/80 (2006.01)  
G06F 9/312 (2006.01)

(52) U.S. Cl. .... 712/22; 712/4; 712/227

(58) Field of Classification Search .... 712/2,  
712/22, 20, 1, 4, 3, 5, 204, 6, 7, 17, 8, 9,  
712/21, 120, 98, 19, 23, 24, 25, 248, 36,  
712/210, 41, 213, 42, 273, 245, 300; 711/201,  
711/153, 208, 148, 209, 171, 212, 172, 219;  
710/50, 51, 66, 33, 127, 34

See application file for complete search history.

## (56) References Cited

## U.S. PATENT DOCUMENTS

3,654,621 A 4/1972 Bock et al. .... 340/172.5

18 Claims, 17 Drawing Sheets

vd[7]	vd[6]	vd[5]	vd[4]	vd[3]	vd[2]	vd[1]	vd[0]	0	702
0	vs[7]	0	vs[6]	0	vs[5]	0	vs[4]	~	704
0	vs[8]	0	vs[2]	0	vs[1]	0	vs[0]	~	706
sign vs[7]	vs[7]	sign vs[6]	vs[6]	sign vs[5]	vs[6]	sign vs[4]	vs[4]	~	708
sign vs[8]	vs[3]	sign vs[2]	vs[2]	sign vs[1]	vs[1]	sign vs[0]	vs[0]	~	710
vs[7]	vs[6]	vs[3]	vs[1]	vt[7]	vt[5]	vt[3]	vt[1]	~	712
vs[6]	vs[4]	vs[2]	vs[0]	vt[6]	vt[4]	vt[2]	vt[0]	~	714
vs[7]	vt[7]	vs[6]	vt[6]	vs[5]	vt[5]	vs[4]	vt[4]	~	716
vs[3]	vt[3]	vs[2]	vt[2]	vs[1]	vt[1]	vs[0]	vt[0]	~	718

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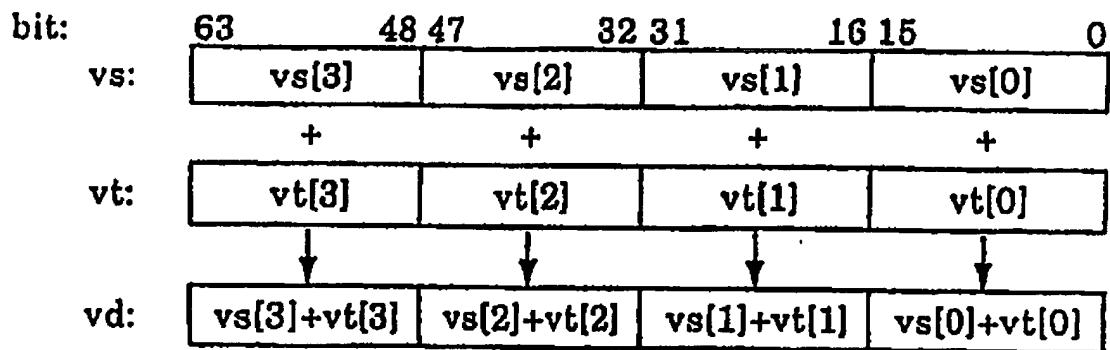


FIG. 1  
(Prior Art)

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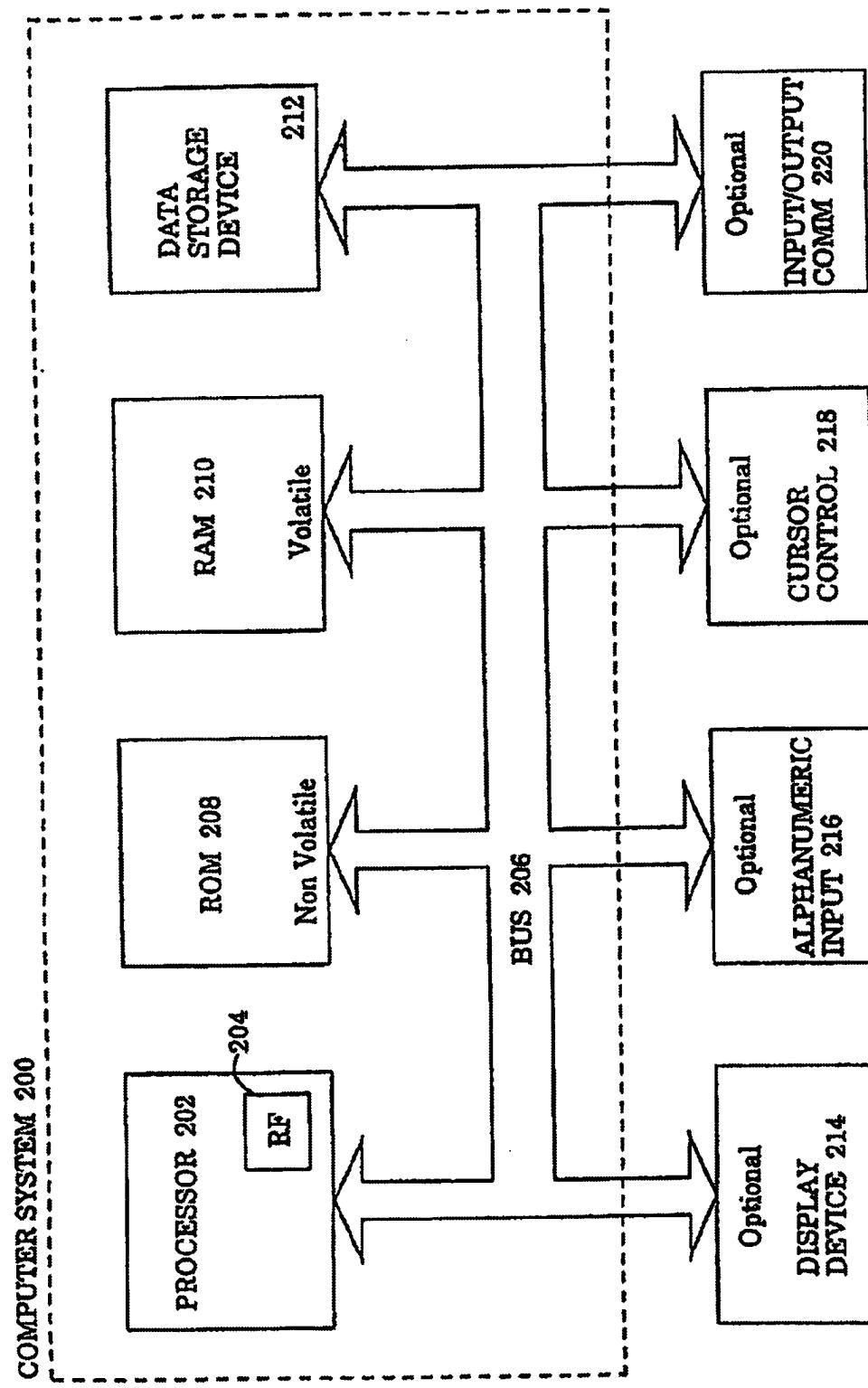


FIG. 2 (Prior Art)

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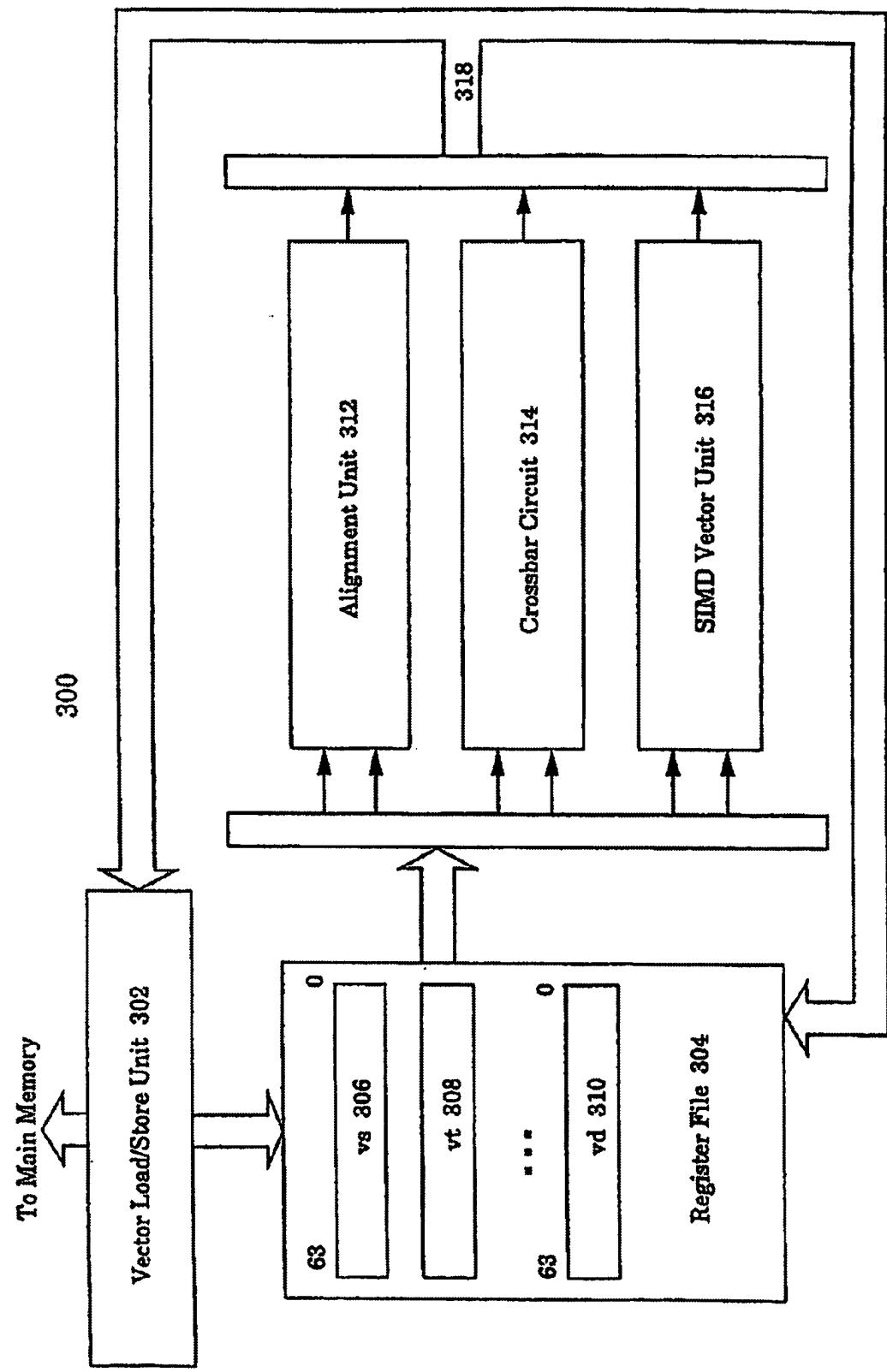


FIG. 3

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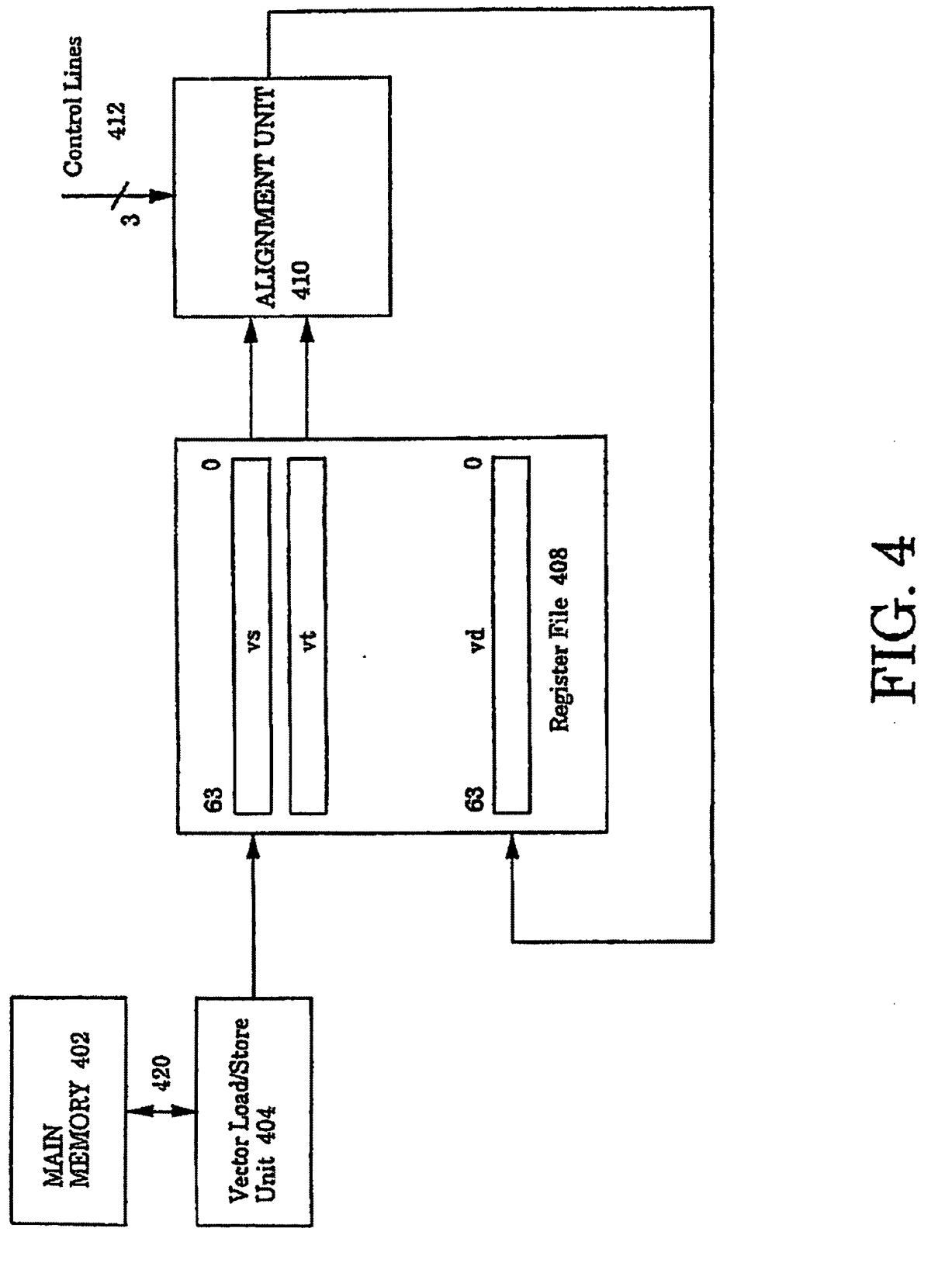


FIG. 4

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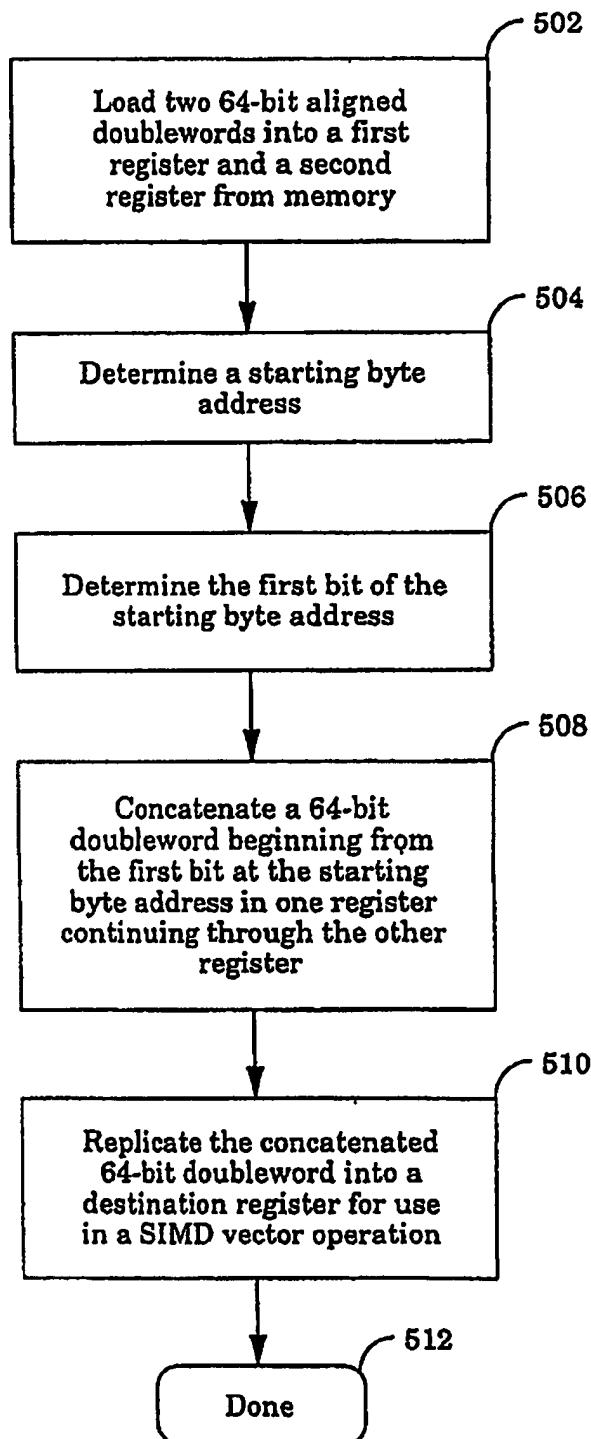


FIG. 5

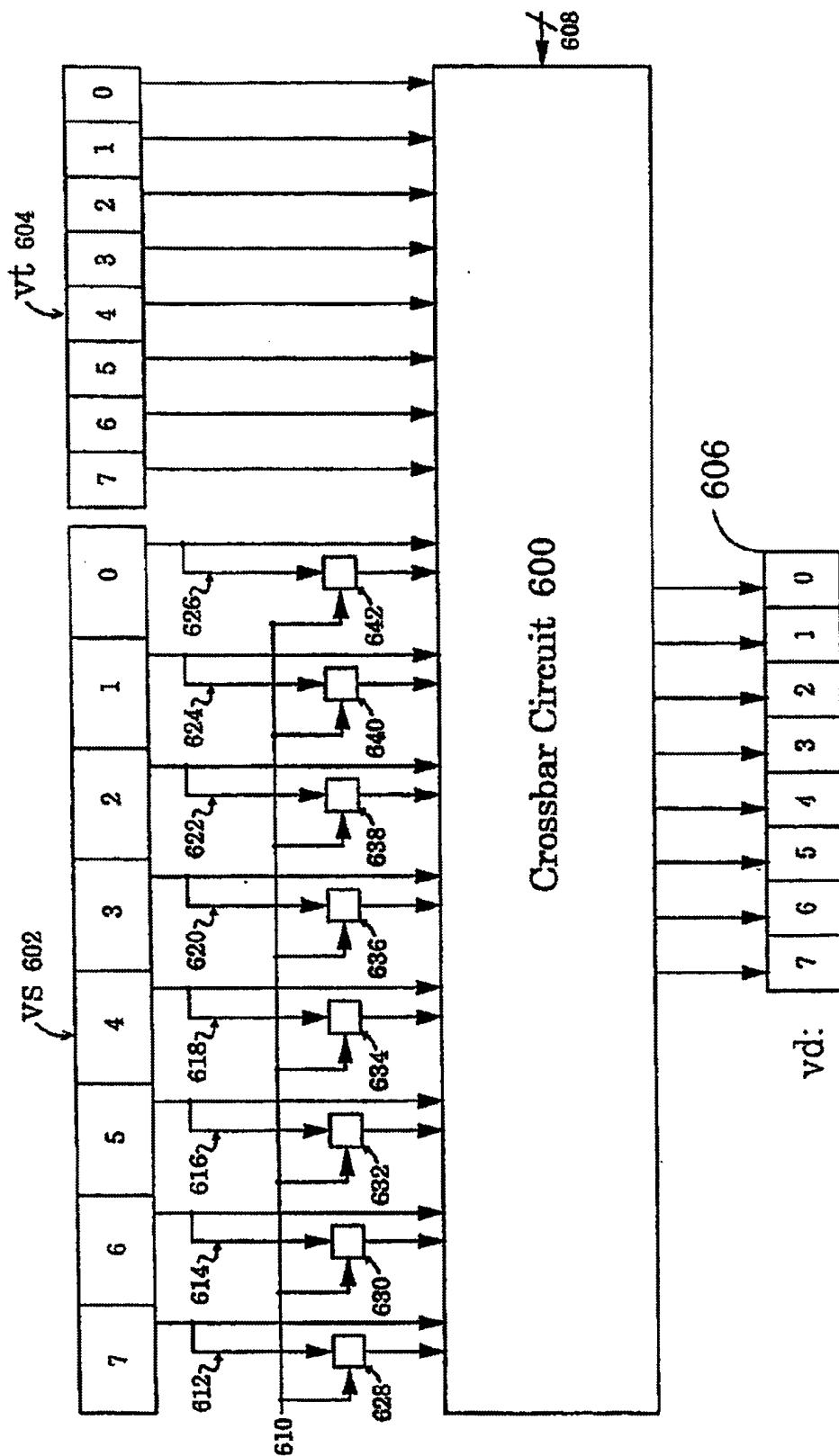


FIG. 6A

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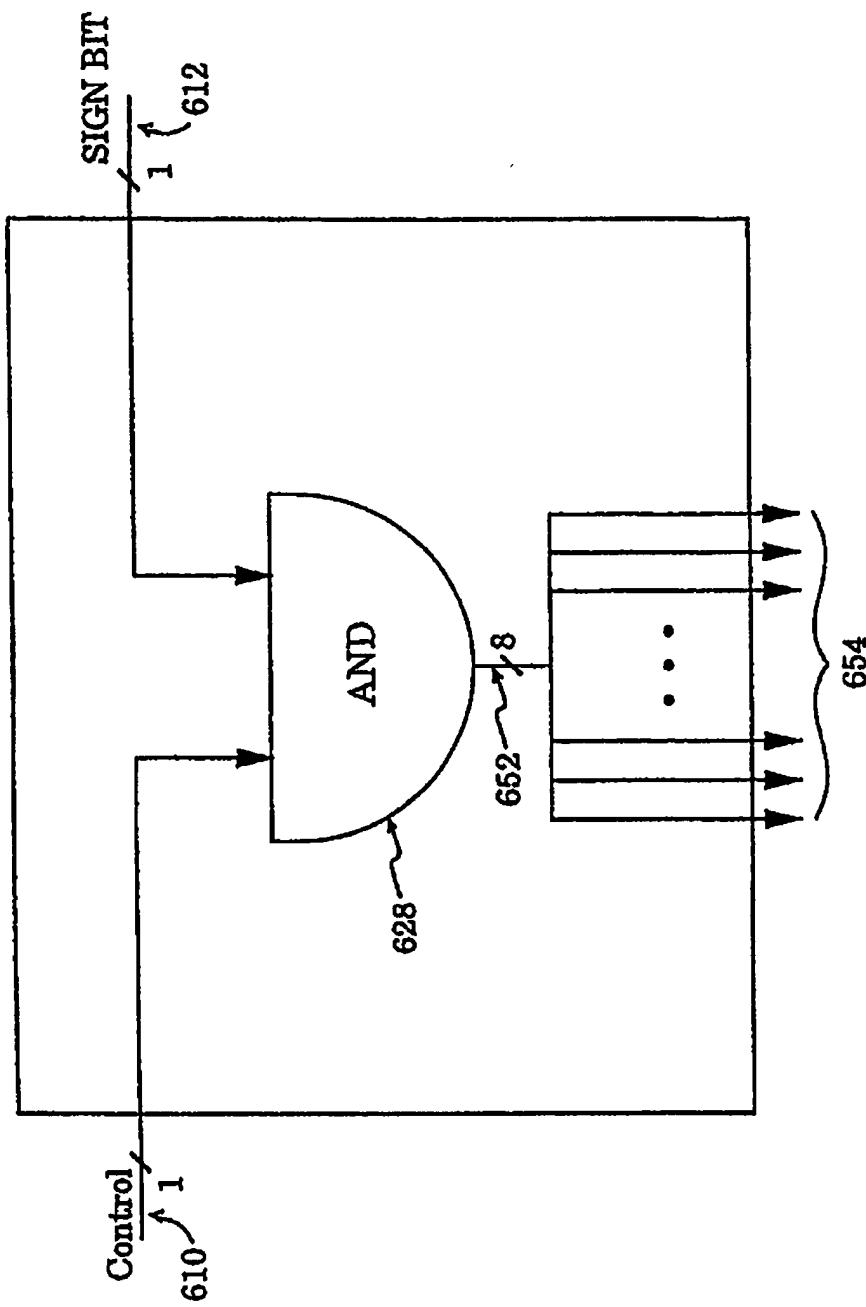


FIG. 6B

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63

vd[7]	vd[6]	vd[5]	vd[4]	vd[3]	vd[2]	vd[1]	vd[0]
0	vs[7]	0	vs[6]	0	vs[5]	0	vs[4]
0	vs[3]	0	vs[2]	0	vs[1]	0	vs[0]
sign vs[7]	vs[7]	sign vs[6]	vs[6]	sign vs[5]	vs[5]	sign vs[4]	vs[4]
sign vs[3]	vs[3]	sign vs[2]	vs[2]	sign vs[1]	vs[1]	sign vs[0]	vs[0]
vs[7]	vs[5]	vs[3]	vs[1]	vt[7]	vt[5]	vt[3]	vt[1]
vs[6]	vs[4]	vs[2]	vs[0]	vt[6]	vt[4]	vt[2]	vt[0]
vs[7]	vt[7]	vs[6]	vt[6]	vt[5]	vs[4]	vt[4]	716
vs[3]	vt[3]	vs[2]	vt[2]	vt[1]	vs[0]	vt[0]	718

0

702  
704  
706  
708  
710  
712  
714

FIG. 7

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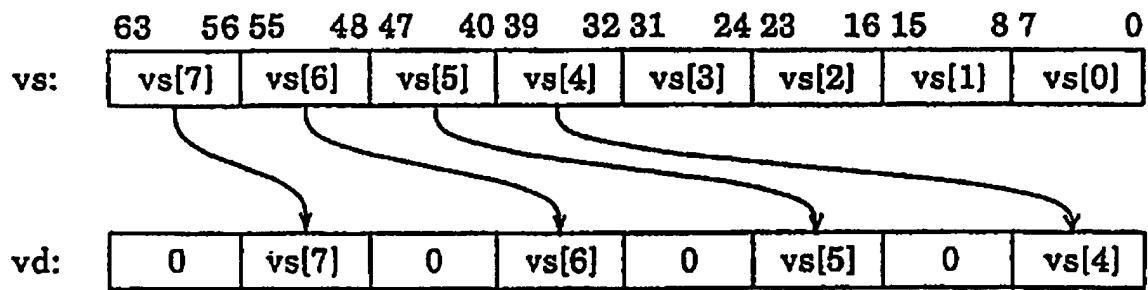
UPUH

FIG. 8A

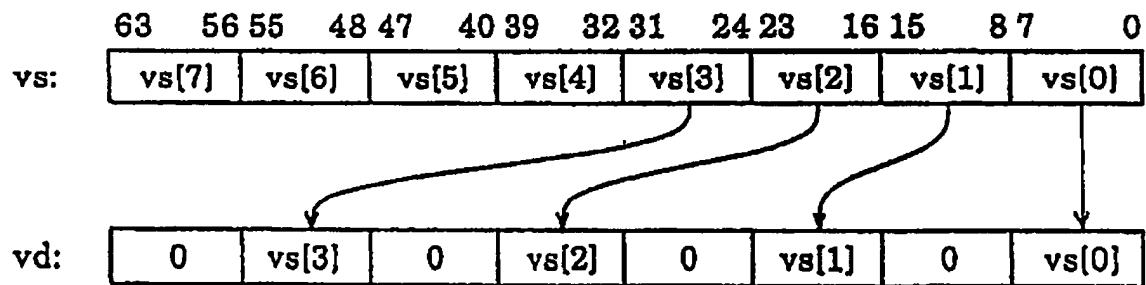
UPUL

FIG. 8B

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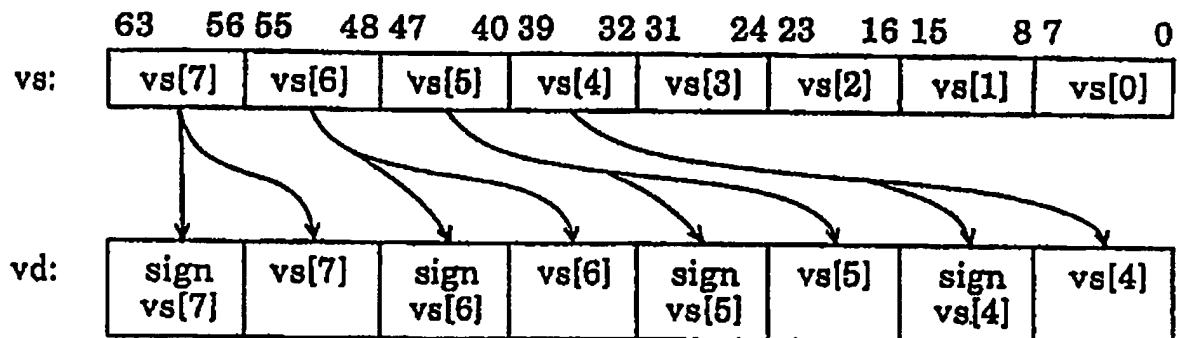
UPSH

FIG. 8C

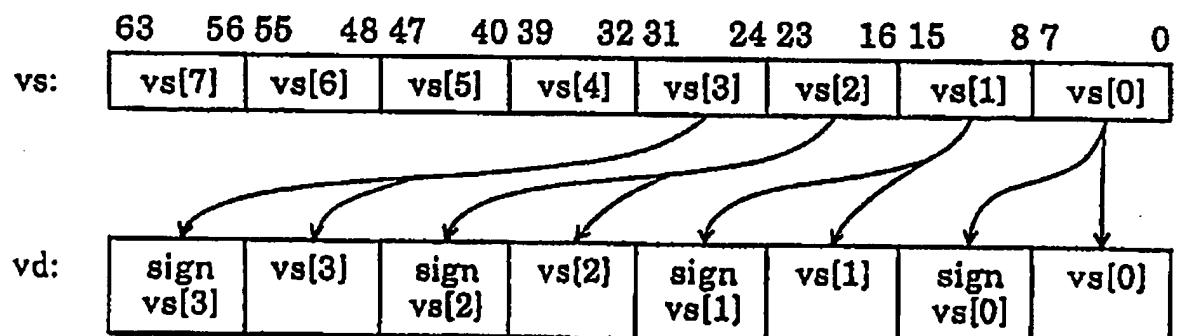
UPSL

FIG. 8D

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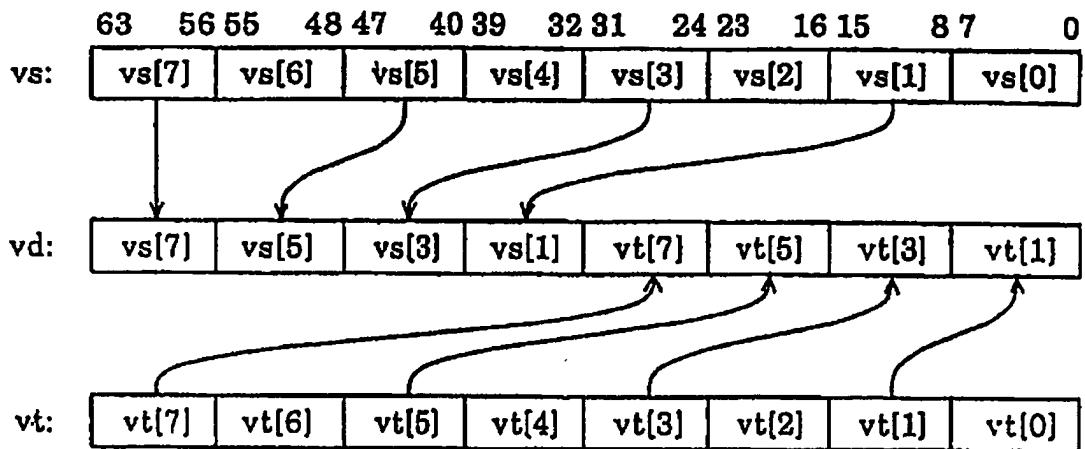
PACH

FIG. 8E

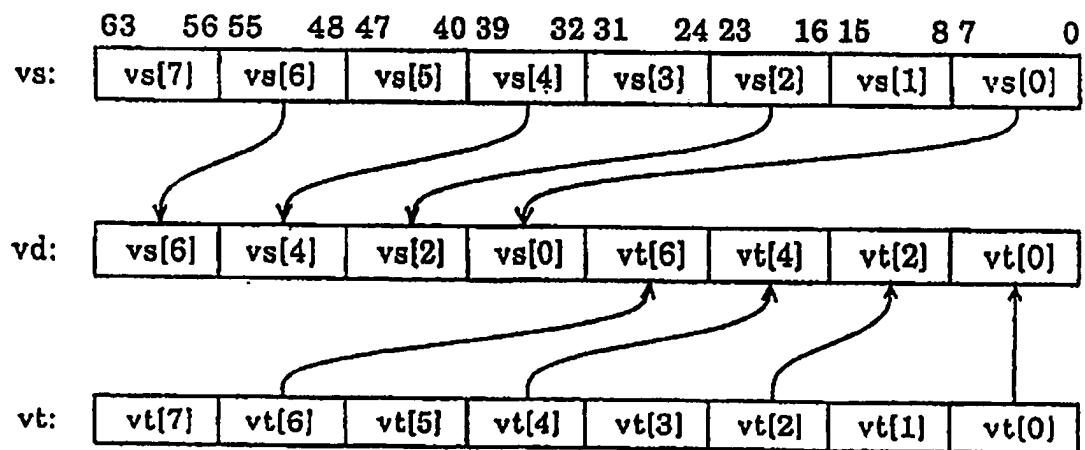
PACL

FIG. 8F

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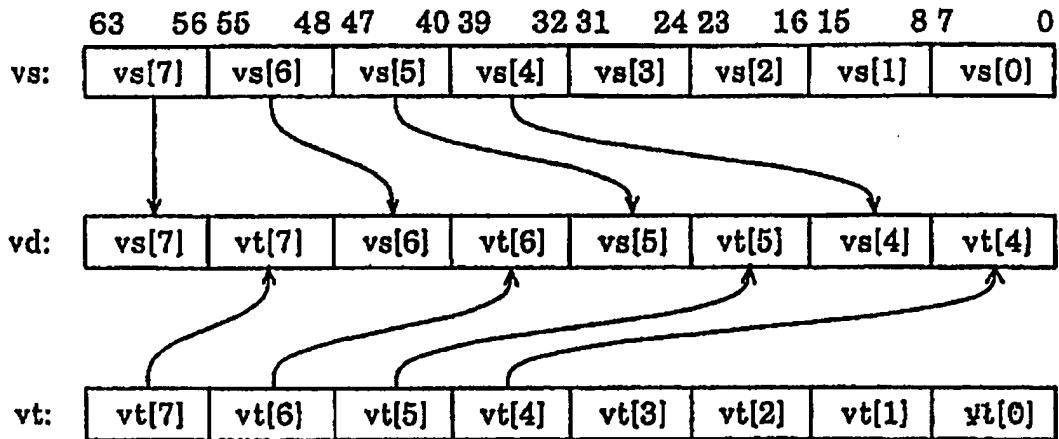
MIXH

FIG. 8G

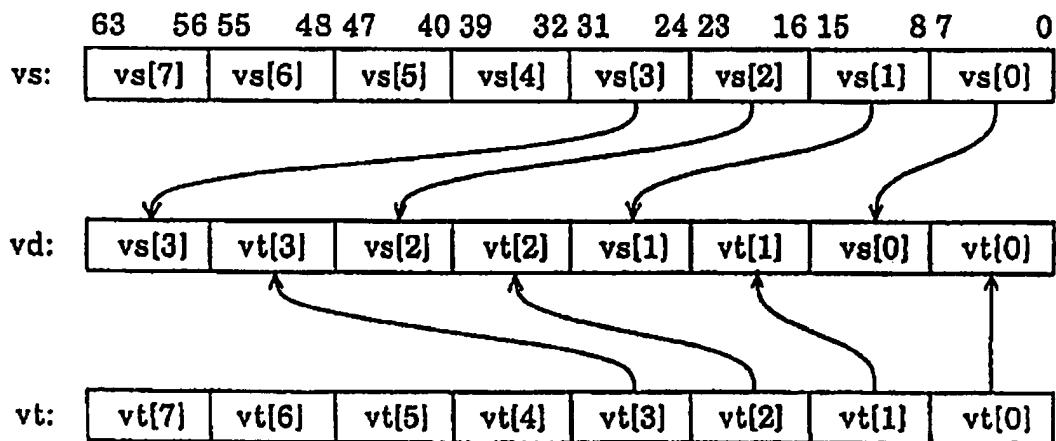
MIXL

FIG. 8H

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63	0	
vd[3]	vd[2]	vd[1]
vs[3]	vt[3]	vs[2]
vs[1]	vt[1]	vs[0]
vs[3]	vs[1]	vt[3]
vs[2]	vs[0]	vt[2]
vs[2]	vt[3]	vs[0]
vs[0]	vt[1]	vs[2]
vs[3]	vs[2]	vt[3]
vs[1]	vs[0]	vt[1]

902  
904  
906  
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912  
914  
916  
918

FIG. 9

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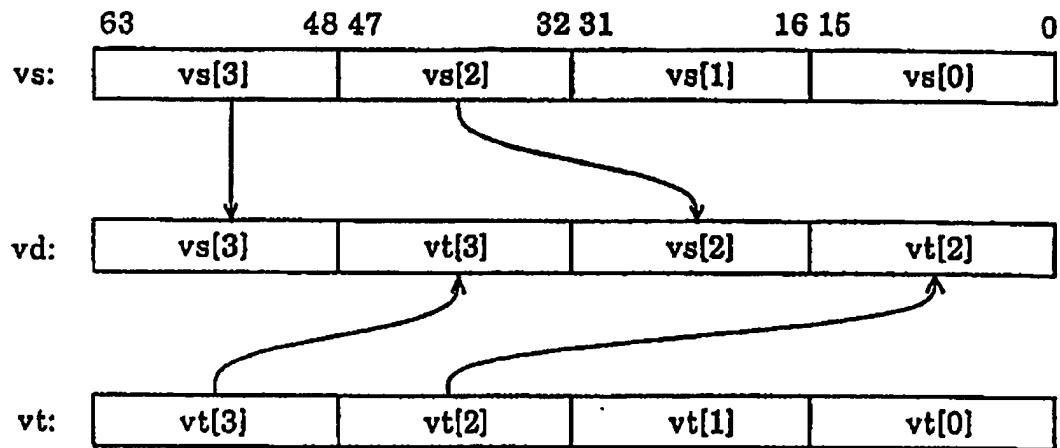
MIXH

FIG. 10A

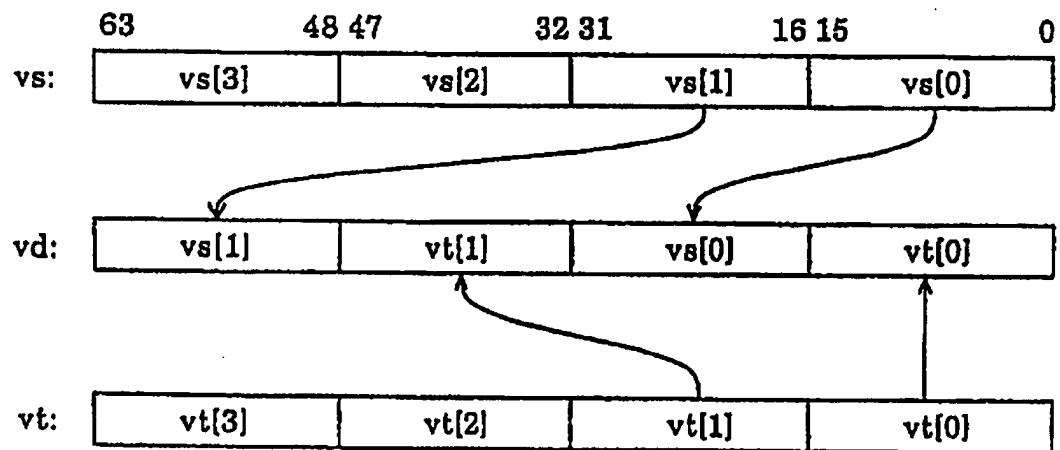
MIXL

FIG. 10B

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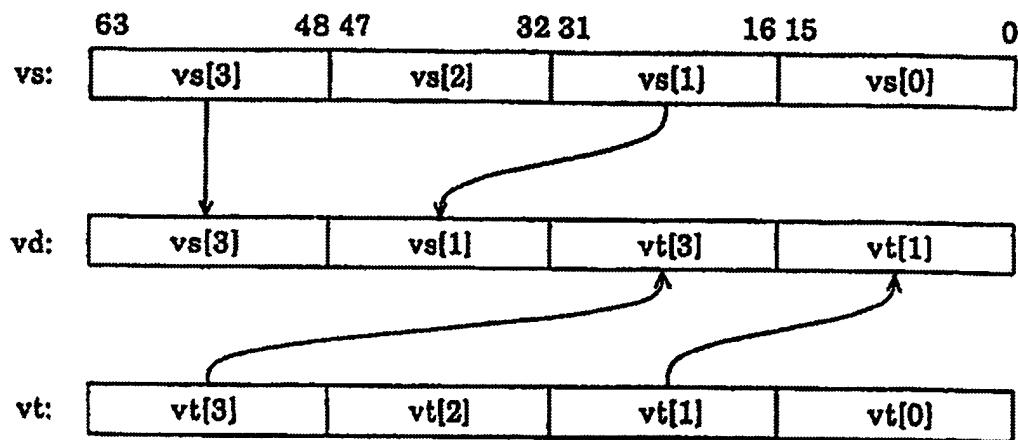
PACH

FIG. 10C

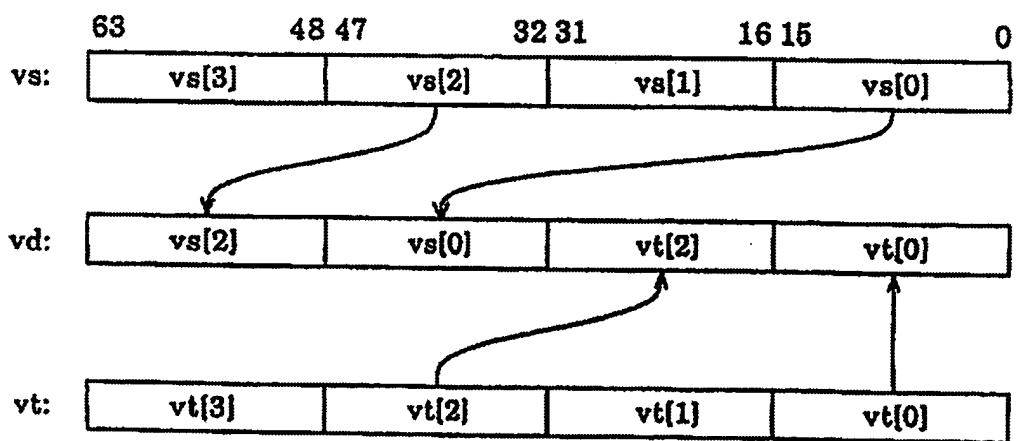
PACL

FIG. 10D

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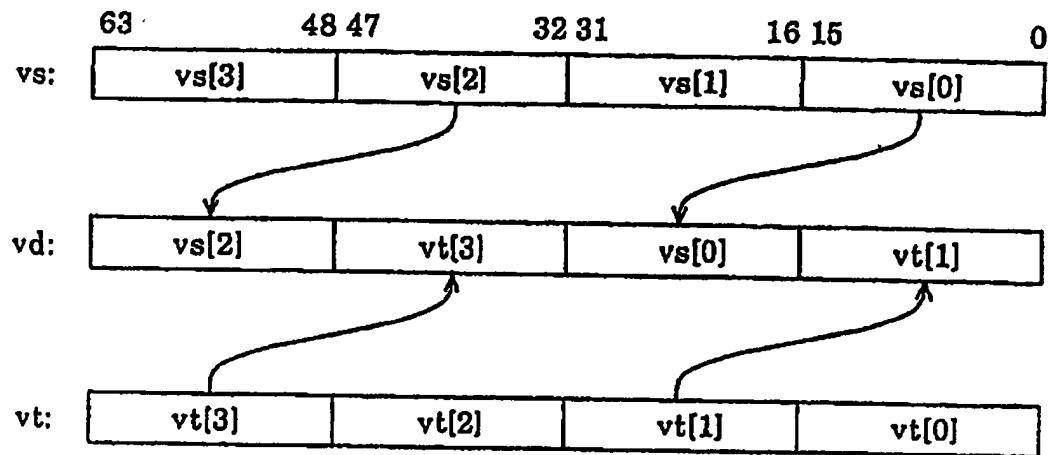
BFLA

FIG. 10E

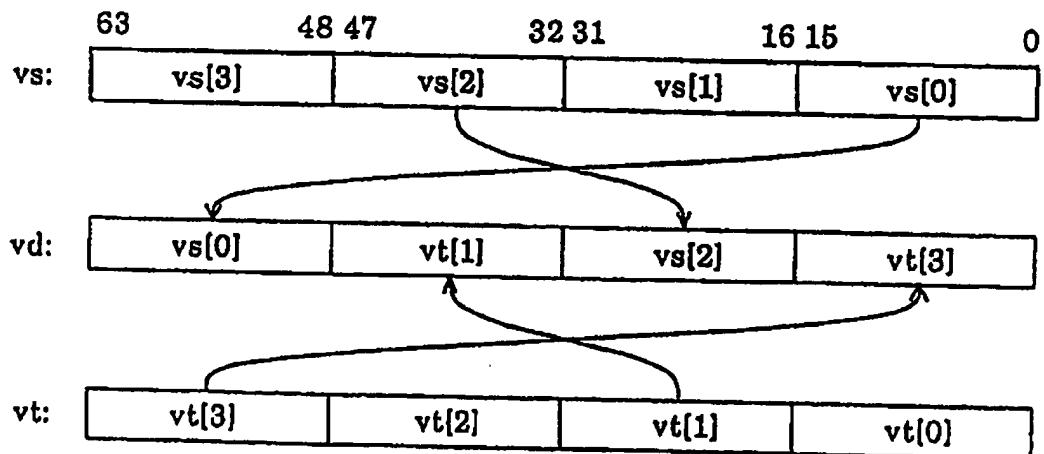
BFLB

FIG. 10F

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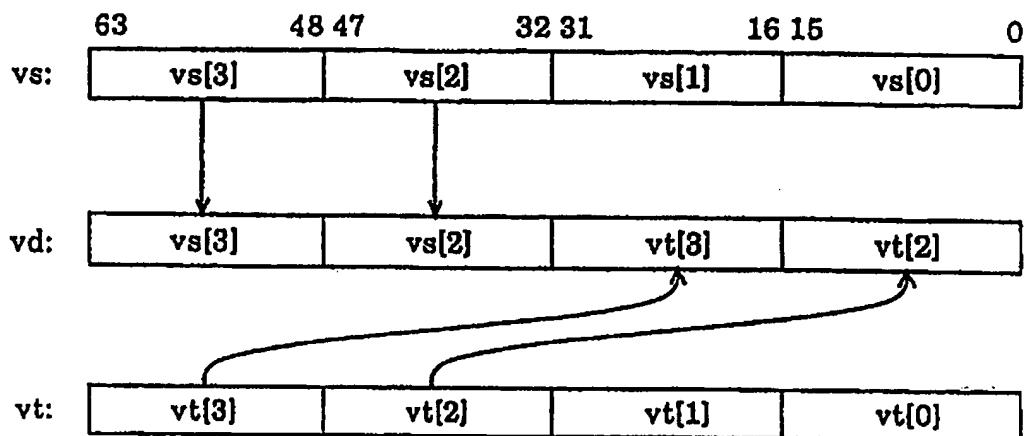
REPA

FIG. 10G

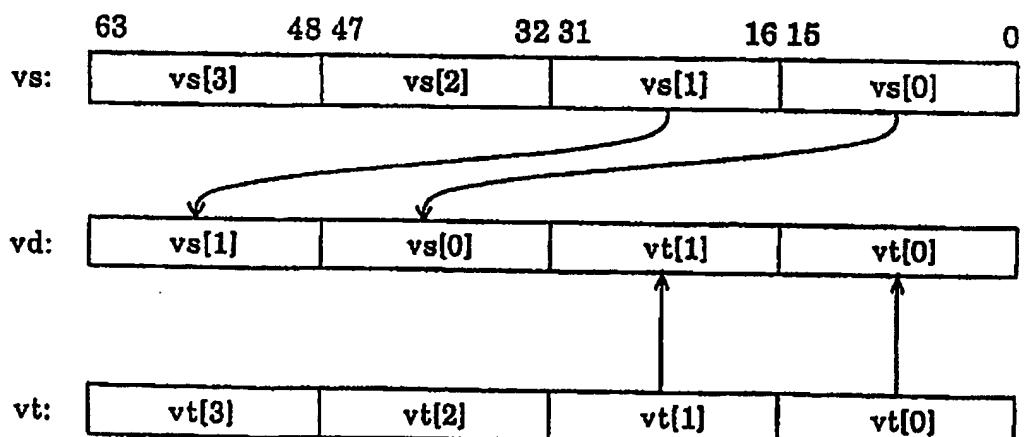
REPB

FIG. 10H